Lesson Plan 1

Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions.

**New View of How Humans Moved Away From Apes**

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**Published: March 10, 2011**

Anthropologists studying living hunter-gatherers have radically revised their view of how early human societies were structured, a shift that yields new insights into how humans evolved away from apes.

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Early human groups, according to the new view, would have been more cooperative and willing to learn from one another than the chimpanzees from which human ancestors split about five million years ago. The advantages of cooperation and social learning then propelled the incipient human groups along a different evolutionary path.

Anthropologists have assumed until now that hunter-gatherer bands consist of people fairly closely related to one another, much as chimpanzee groups do, and that kinship is a main motive for cooperation within the group. Natural selection, which usually promotes only selfish behavior, can reward this kind of cooperative behavior, called kin selection, because relatives contain many of the same genes.

A team of anthropologists led by Kim R. Hill of [Arizona State University](http://topics.nytimes.com/top/reference/timestopics/organizations/a/arizona_state_university/index.html?inline=nyt-org) and Robert S. Walker of the [University of Missouri](http://topics.nytimes.com/top/reference/timestopics/organizations/u/university_of_missouri/index.html?inline=nyt-org) analyzed data from 32 living hunter-gatherer peoples and found that the members of a band are not highly related. Fewer than 10 percent of people in a typical band are close relatives, meaning parents, children or siblings, they report in Friday’s issue of [Science](http://www.sciencemag.org).

Michael Tomasello, a psychologist at the [Max Planck Institute for Evolutionary Anthropology](http://www.eva.mpg.de/english) in Germany, said the survey provided a strong foundation for the view that cooperative behavior, as distinct from the fierce aggression between chimp groups, was the turning point that shaped human evolution. If kin selection was much weaker than thought, Dr. Tomasello said, “then other factors like reciprocity and safeguarding one’s reputation have to be stronger to make cooperation work.”

The finding corroborates an influential new view of early human origins advanced by Bernard Chapais, a primatologist at the University of Montreal, in his book “Primeval Kinship” (2008). Dr. Chapais showed how a simple development, the emergence of a pair bond between male and female, would have allowed people to recognize their relatives, something chimps can do only to a limited extent. When family members dispersed to other bands, they would be recognized and neighboring bands would cooperate instead of fighting to the death as chimp groups do.

In chimpanzee societies, males stay where they are born and females disperse at puberty to neighboring groups, thus avoiding incest. The males, with many male relatives in their group, have a strong interest in cooperating within the group because they are defending both their own children and those of their brothers and other relatives.

Human hunter-gatherer societies have been assumed to follow much the same pattern, with female dispersal being the general, though not universal, rule and with members of bands therefore being closely related to one another. But Dr. Hill and Dr. Walker find that though it is the daughters who move in many hunter-gatherer societies, the sons leave the home community in many others. In fact, the human pattern of residency is so variable that it counts as a pattern in itself, one that the researchers say is not known for any species of ape or monkey. Dr. Chapais calls this social pattern “bilocality.”

Modern humans have lived as hunter-gatherers for more than 90 percent of their existence as a species. If living hunter-gatherers are typical of ancient ones, the new data about their social pattern has considerable bearing on early human evolution.

On a genetic level, the finding that members of a band are not highly interrelated means that “inclusive fitness cannot explain extensive cooperation in hunter-gatherer bands,” the researchers write. Some evolutionary biologists believe that natural selection can favor groups of people, not just individuals, but the idea is hotly disputed.

Dr. Hill said group selection, too, could not operate on hunter-gatherer bands because individuals move too often between them, which undoes any selective effect. But hunter-gatherers probably lived as tribes split into many small bands of 30 or so people. Group selection could possibly act at the level of the tribe, Dr. Hill said, meaning that tribes with highly cooperative members would prevail over those that were less cohesive, thus promoting genes for cooperation.

The new data on early human social structure furnishes the context in which two distinctive human behaviors emerged, those of cooperation and social learning, Dr. Hill said. A male chimp may know in his lifetime just 12 other males, all from his own group. But a hunter-gatherer, because of cooperation between bands, may interact with a thousand individuals in his tribe. Because humans are unusually adept at social learning, including copying useful activities from others, a large social network is particularly effective at spreading and accumulating knowledge.

Knowledge can in fact be lost by hunter-gatherers if a social network gets too small. One group of the Ache people of Paraguay, cut off from its home territory, had lost use of fire when first contacted. Tasmanians apparently forgot various fishing techniques after rising sea levels broke their contact with the Australian mainland 10,000 years ago.

Dr. Chapais said that the new findings “validate and enrich” the model of human social evolution proposed in his book. “If you take the promiscuity that is the main feature of chimp society, and replace it with pair bonding, you get many of the most important features of human society,” he said.

Recognition of relatives promoted cooperation between neighboring bands, in his view, allowing people to move freely from one to another. Both sons and daughters could disperse from the home group, unlike chimp society, where only females can disperse. But this cooperation did not mean that everything was peaceful. The bands were just components of tribes, between which warfare may have been intense. “Males could remain as competitive and xenophobic as before at the between-tribe level,” Dr. Chapais writes.

1. According to this article, why did humans evolve separately from apes?
2. Do you think that this is a good example of how we evolved separately? Why or why not?
3. What are some other possible reasons we evolved separately?
4. How close do you think that we are related to apes?
5. What is our common ancestor with apes?

Lesson Two

## Animal Adaptations: Focus on Bird Beaks

**Materials:**

* **Beaks:** 2 eyedroppers, 1 pliers, 5 sets of chopsticks, 4 tweezers, 1 shoestring, 1 sponge strip, 1 straw, 1 wrench, 2 slotted spoons, 1 strainer, 3 tongs, 1 envelope, 1 turkey skewer;
* **Food:** colored water in a long narrow container, gummy worms, sunflower seeds, styrofoam cubes, popped popcorn, rice, marshmallows, loose tea;
* **Other:** potting soil, shallow pans, 8 boxes, data tables for each student, 8 cups, vase or graduated cylinder, pictures of various birds with corresponding environment/habitat and food source

**Procedure:** For each challenge, record your data and construct a bar graph.

*Challenge #1*

You have been given a graduated cylinder as a food source. You have also been given sample beaks: 1) a shoestring, 2) a medicine dropper, and 3) a sponge strip. Your challenge is to find out how many seconds it takes each "beak" to get 10mL of water from the graduated cylinder to the cup.   
Record the three times in the data table provided. Try several trials with each "beak." Calculate the average time for each "beak." Construct a bar graph of the averages on a separate piece of paper.

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| --- | --- |
| Beak Type | Average Time (seconds) |
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*Challenge #2*

You have been given gummy worms as your food source. You have also been given sample beaks: 1) a straw, 2) chopsticks, and 3) a wrench. Your challenge is to find out how many seconds it takes to remove the gummy worms form the dirt using each "beak." Use multiple trials, burying the worms after each trial.   
Record your times in the data table. Calculate the average time for each "beak." Construct a bar graph of the averages on a separate piece of paper. .

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| --- | --- |
| Beak Type | Average Time (seconds) |
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*Challenge #3*

You have been given sunflower seeds as your food source. You have also been given sample beaks: 1) pliers, 2) chopsticks, and 3) tweezers. Your challenge is to find out how many seconds it takes each "beak" to crack the shell and remove the seed inside.   
Record your times in the data table. Try this several times. Calculate the average time for each "beak.' Construct a bar graph of the averages on a separate piece of paper.

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| --- | --- |
| Beak Type | Average Time (seconds) |
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*Challenge #4*

You have been given floating styrofoam squares as your food source. You have also been given sample beaks: 1) chopsticks, 2) tweezers, and 3) a slotted spoon. Your challenge is to find out how many seconds it takes each "beak" to remove all of the styrofoam square from the water. Try several trials, returning the squares after each trial.   
Record your times in the data table. Try this several times. Calculate the average time for each "beak.' Construct a bar graph of the averages on a separate piece of paper.

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| Beak Type | Average Time (seconds) |
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*Challenge #5*

You have been given tea as your food source. You have also been provided sample beaks: 1) a slotted spoon, 2) a strainer, and 3) tweezers. Your challenge is to find out how many seconds it takes to get all of the tea from the water. Try this several times, returning the materials each time.   
Record your times in the data table. Try this several times. Calculate the average time for each "beak.' Construct a bar graph of the averages on a separate piece of paper.

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| Beak Type | Average Time (seconds) |
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*Challenge #6*

You have been given popped popcorn as your food source. You have also been provided sample beaks: 1) tongs, 2) an envelope, and 3) chopsticks. A group member will gently toss some kernels into the air. Your challenge is to find out how many seconds it takes to capture 20 kernels with each "beak." The kernels must be caught while they are in the air. Try this several times.   
Record your times in the data table. Try this several times. Calculate the average time for each "beak.' Construct a bar graph of the averages on a separate piece of paper.

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| --- | --- |
| Beak Type | Average Time (seconds) |
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|  |  |

*Challenge #7*

You have been given rice as your food source. You have also been provided sample beaks: 1) a medicine dropper, 2) tongs, and 3) tweezers. Your challenge is to find out how many seconds it takes for each "beak" to remove thirty grains of rice from the bark of a tree. Try this several times, returning the rice to the bark each time.   
Record your times in the data table. Try this several times. Calculate the average time for each "beak.' Construct a bar graph of the averages.

|  |  |
| --- | --- |
| Beak Type | Average Time (seconds) |
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*Challenge #8*

You have been given marshmallows hanging from a string as your food source. You have also been provided sample beaks: 1) chopsticks, 2) tongs, and 3) a turkey skewer. Your challenge is to find out how many seconds it takes with each "beak" to remove five marshmallows from the strings. Try this several times.   
Record your times in the data table. Try this several times. Calculate the average time for each "beak." Construct a bar graph of the averages.

|  |  |
| --- | --- |
| Beak Type | Average Time (seconds) |
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|  |  |
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1.) Why did some beaks work better than the others?

2.) How does this explain animal adaptations?

3.) What are some other examples of animal adaptations?

4.) Why do animals need to adapt?

Lesson Three-

Peppered Moth Simulation

Objectives:

Describe the importance of coloration in avoiding predation  
Relate environmental change to changes in organisms  
Explain how natural selection causes populations to change

Materials:

Sheet of white paper  
Newspaper  
Forceps  
Colored Pencils  
Clock with Second Hand  
30 newspaper circles (made with hole punch)  
30 white circles (made with hole punch)

Purpose: In this lab, you will simulate how predators locate prey in different environments. You will analyze how color affects and organism's ability to survive in certain environments.

Industrial Melanism is a term used to describe the adaptation of a population in response to pollution. One example of rapid industrial melanism occurred in populations of peppered moths in the area of Manchester, England from 1845 to 1890. Before the industrial revolution, the trunks of the trees in the forest around Manchester were light grayish-green due to the presence of lichens. Most of the peppered moths in the area were light colored with dark spots. As the industrial revolution progressed, the treee trunks became covered with soot and turned dark. Over a period of 45 years, the dark variety of the peppered moth became more common.

Procedure.

1. Place a sheet of white paper on the table and have one person spread 30 white circles and 30 newspaper circles over the surface while the other person isn't looking.  
2. The "predator" will then use forceps to pick up as many of the circles as he can in 15 seconds.  
3. This trial will be repeated with white circles on a newspaper background, newspaper circles on a white background, and newspaper circles on a newspaper background. Record the data in chart below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Starting Population | | Number Picked up | |
| Trial | Background | Newspaper | White | White | Newspaper |
| 1 | white | 30 | 30 |  |  |
| 2 | white | 30 | 30 |  |  |
| 3 | newspaper | 30 | 30 |  |  |
| 4 | newspaper | 30 | 30 |  |  |

Analysis

1. What did the experiment show about how prey are selected by predators?

2. What moth coloration is the best adaptation for a dark (newspaper) background? How do you know?

3. What would you expect the next generation of moths to look like after trial 1? What about the next generation after trial 3?

4. How does the simulation model natural selection?

5. Examine the table and construct a graph. Plot the years of the study on the X-axis, and the number of moths captured on the Y axis. You should have 2 lines on your graph - one for light moths, and one for dark moths.

|  |  |  |
| --- | --- | --- |
| Year | # of light Moths Captured | # of Dark Moths Captured |
| 2 | 537 | 112 |
| 3 | 484 | 198 |
| 4 | 392 | 210 |
| 5 | 246 | 281 |
| 6 | 225 | 337 |
| 7 | 193 | 412 |
| 8 | 147 | 503 |
| 9 | 84 | 550 |
| 10 | 56 | 599 |

Make Graph below

6. Explain in your own words what the graph shows.

7. Describe a situation where this type of selection might occur.